

Problem 1-10



First, we will look up the standard free energies and enthalpies of formation at 25°C for N_2 , H_2 , and NH_3 *

| Species | $\Delta G_{f,i}^\circ$ (kcal/mole) | $\Delta H_{f,i}^\circ$ (kcal/mole) |
|---------------|------------------------------------|------------------------------------|
| N_2 | 0.00 | 0.00 |
| H_2 | 0.00 | 0.00 |
| NH_3 | -3.90 | -10.96 |

$$\Delta G_R^\circ = \sum_i \nu_i \Delta G_{f,i}^\circ = (+2)(-3.90) = -7.80 \text{ kcal/mole}$$

$$\Delta H_R^\circ = \sum_i \nu_i \Delta H_{f,i}^\circ = (+2)(-10.96) = -21.92 \text{ kcal/mole}$$

However, we need to be careful about "per mole". For the reaction as written, these changes are per mole of N_2 . When 1 mole of N_2 disappears, the change in G° is -7.80 kcal and the change in H° is -21.92 kcal.

The values of ΔG_R° and ΔH_R° per mole of NH_3 are $1/2$ of those calculated above.

The values of ΔG_R° and ΔH_R° per mole of H_2 are $1/3$ of those calculated above.

*Perry, "Chemical Engineers Handbook" (6th ed.), Table 3-206 (p. 3-177-3-159)